

REMARKS

The Official Action mailed March 3, 2003, has been received and its contents carefully noted. This response is filed within three months of the mailing date of the Official Action and therefore is believed to be timely without extension of time. Accordingly, the Applicant respectfully submits that this response is being timely filed.

The Applicant notes with appreciation the consideration of the Information Disclosure Statements filed on January 24, 2002, March 19, 2002, and February 16, 2005.

Claims 1-39 are pending in the present application, of which claims 1-3, 23 and 28-30 are independent. Claims 1, 23 and 28 have been amended to better recite the features of the present invention. For the reasons set forth in detail below, all claims are believed to be in condition for allowance. Favorable reconsideration is requested.

The Official Action rejects claims 1-39 as obvious based on the combination of U.S. Patent Application Publication No. 2002/0098635 to Zhang et al. and U.S. Patent No. 5,966,596 to Ohtani et al. The Applicant respectfully traverses the rejection because the Official Action has not made a *prima facie* case of obviousness. Also, the Applicant respectfully submits that a *prima facie* case of obviousness cannot be maintained against independent claims 1, 23 and 28 of the present application, as amended.

As stated in MPEP §§ 2142-2143.01, to establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. Obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion, or motivation to do so found either explicitly or implicitly in the

references themselves or in the knowledge generally available to one of ordinary skill in the art. "The test for an implicit showing is what the combined teachings, knowledge of one of ordinary skill in the art, and the nature of the problem to be solved as a whole would have suggested to those of ordinary skill in the art." In re Kotzab, 217 F.3d 1365, 1370, 55 USPQ2d 1313, 1317 (Fed. Cir. 2000). See also In re Fine, 837 F.2d 1071, 5 USPQ2d 1596 (Fed. Cir. 1988); In re Jones, 958 F.2d 347, 21 USPQ2d 1941 (Fed. Cir. 1992).

The prior art, either alone or in combination, does not teach or suggest all the features of the independent claims. Independent claims 1, 23 and 28 have been amended to recite that a chemical oxide film is formed by using a liquid chemical after crystallization. For the reasons provided below, Zhang and Ohtani, either alone or in combination, do not teach or suggest the above-referenced features of the present invention.

The Official Action asserts that "Ohtani et al. teaches an advantage of forming the oxide layer by this method which is to improve the surface characteristics of the underlying film ... and the resulting advantage, would instruct one of ordinary skill in the art to form the oxide layer of Zhang et al. by the method of Ohtani et al. ... [because] the improved surface characteristics allow for a nickel catalyst to be used in Ohtani et al., which accelerates the crystallization of the amorphous film" (pages 21-22, Paper No. 20050224). However, claims 1, 23 and 28 have been amended to recite that a chemical oxide film is formed by using a liquid chemical after crystallization. Ohtani's chemical oxide is formed before crystallization to accelerate crystallization (column 7, lines 12-48). In the claims of the present application, a chemical oxide film (protective film) is formed before the doping step, not before the crystallization step (after the crystallization step), because the chemical oxide film prevents the silicon-based semiconductor film from being etched (or ion-bombardment) (see, e.g., page 3, lines 2-19 of the present specification). These features are not taught or suggested by Zhang either alone or in combination with Ohtani.

Independent claims 2, 3, 29 and 30 recite terminating dangling bonds on a surface of a semiconductor film comprising silicon with oxygen (or with an element to be bonded with bonding energy higher than that of Si-H bonds). For the reasons provided below, Zhang and Ohtani, either alone or in combination, do not teach or suggest the above-referenced features of the present invention.

The Official Action asserts "that UV light [of Ohtani] increases the reactivity of the oxygen atoms, and it is clear ... that the oxygen molecules react on the surface of the substrate, thus terminating the dangling bonds on the surface of the semiconductor film with oxygen" (page 6, Paper No. 20050224). The Applicant respectfully disagrees and traverses the above-referenced assertions in the Official Action.

Ohtani only discloses that the "thin oxide film can be formed by ultraviolet radiation within an oxygen ambient or immersing the substrate in ozone water or hydrogen peroxide water" (column 2, lines 44-46). That is, Ohtani only appears to disclose a method of forming a thin oxide film, but does not teach or suggest chemical structures.

As shown in the specification, one of the features of the present invention is terminating unsaturated bonds (dangling bonds) present at the surface of the amorphous silicon film with oxygen (or with an element to be bonded with bonding energy higher than that of Si-H bonds) (page 6, lines 1-11). As described above, the unsaturated bonds are originally present at the surface of the amorphous silicon and the unsaturated bonds are terminated with oxygen (or with an element to be bonded with bonding energy higher than that of Si-H bonds). At this time, "the unsaturated bonds become Si-O bonds and the bonding energy (193.5 kcal/mol) of the Si-O bonds is higher than that (71.5 kcal/mol) of Si-H bonds" (*Id.*). That is, only the surface where the unsaturated bonds are present is terminated with oxygen (or with an element to be bonded with bonding energy higher than that of Si-H bonds).

This is very different form forming a chemical oxide or a thin film, because these films are formed by oxidizing the whole surface of the amorphous silicon film (e.g., page

4, lines 21-23). Therefore, Ohtani and Zhang, either alone or in combination, do not teach or suggest terminating dangling bonds with oxygen (or with an element to be bonded with bonding energy higher than that of Si-H bonds).

Since Zhang and Ohtani do not teach or suggest all the claim limitations, a *prima facie* case of obviousness cannot be maintained.

Furthermore, there is no suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify Zhang and Ohtani or to combine reference teachings to achieve the claimed invention. MPEP § 2142 states that the examiner bears the initial burden of factually supporting any *prima facie* conclusion of obviousness. It is respectfully submitted that the Official Action has failed to carry this burden. While the Official Action relies on various teachings of the cited prior art to disclose aspects of the claimed invention and asserts that these aspects could be used together, it is submitted that the Official Action does not adequately set forth why one of skill in the art would combine the references to achieve the features of the present invention.

The test for obviousness is not whether the references "could have been" combined or modified as asserted in the Official Action, but rather whether the references should have been. As noted in MPEP § 2143.01, "The mere fact that references can be combined or modified does not render the resultant combination obvious unless the prior art also suggests the desirability of the combination." *In re Mills*, 916 F.2d 680, 16 USPQ2d 1430 (Fed. Cir. 1990) (emphasis in original). Thus, it is respectfully submitted that the standard set forth in the Official Action is improper to support a finding of *prima facie* obviousness.

The Official Action concedes that Zhang does not teach "the method of forming a chemical oxide film" (page 3, Paper No. 20050224). The Official Action implicitly concedes that Zhang also does not teach a method of forming a chemical oxide film on a surface of a semiconductor film comprising silicon by using a liquid chemical. The Official Action relies on Ohtani to allegedly teach "a method of forming a chemical oxide

film using a liquid chemical" (*Id.*). The Official Action asserts that "[i]t would have been obvious to one of ordinary skill in the art at the time the invention was made to form the oxide layer of Zhang et al. by the method of Ohtani et al., since the method of forming an oxide layer lacks criticality in the invention of Zhang et al., and since the method of Ohtani is a known method of forming an oxide" (page 3, Paper No. 20050224). The Official Action also asserts that the method of Ohtani has an advantage in that it "improves the surface characteristics of the underlying film," and the Official Action implies that it would have been obvious to change the surface characteristics of Zhang due to this teaching in Ohtani. The Applicant respectfully disagrees and traverses the above-referenced assertions in the Official Action.

The fact that Zhang does not disclose a method for forming an oxide layer does not mean that any known method could be used to form an oxide layer by one of ordinary skill in the art at the time of the present invention. For example, there is no showing in Zhang that teaches or suggests that the surface characteristics of the underlying film of Zhang are of any concern, or that these concerns could or should be solved by combining Zhang with Ohtani.

Also, it is not clear why one of ordinary skill in the art who was concerned with "the surface characteristics of the underlying film" would not have simply practiced Ohtani alone. It is unclear why it would have been desirable to combine Zhang and Ohtani at the time of the present invention. Therefore, the Official Action has not shown sufficient motivation in Zhang or Ohtani to teach or suggest that the references could or should be combined.

Further, with respect to amended independent claims 1, 23 and 28, it would not be appropriate to apply Ohtani's chemical oxide to Zhang's protective film, because Zhang's protective film is formed before the doping step and after the crystallization step ([0117], [0118]), while Ohtani's chemical oxide is formed before the crystallization (column 7, lines 12-48). The steps and purposes of those steps are different from each

other. Therefore, it is not appropriate to combine Ohtani's chemical oxide to Zhang's protective film.

In the present application, it is respectfully submitted that the prior art of record, either alone or in combination, does not expressly or impliedly suggest the claimed invention and the Official Action has not presented a convincing line of reasoning as to why the artisan would have found the claimed invention to have been obvious in light of the teachings of the references.

For the reasons stated above, the Official Action has not formed a proper *prima facie* case of obviousness. Accordingly, reconsideration and withdrawal of the rejections under 35 U.S.C. § 103(a) are in order and respectfully requested.

Should the Examiner believe that anything further would be desirable to place this application in better condition for allowance, the Examiner is invited to contact the undersigned at the telephone number listed below.

Respectfully submitted,



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